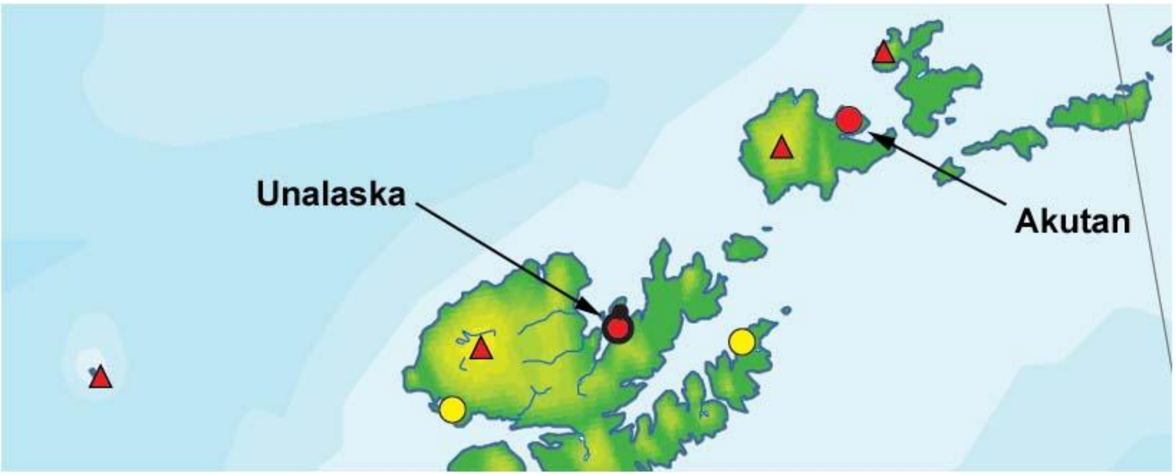
UNALASKA



General Community Information

Unalaska is located near, 800 miles southwest of Anchorage. The population of Unalaska is approximately 4768 people [1].

Unalaska's median household income, $85,455, is nearly 15% higher than the state's median of $69,014, but the poverty rate, 12%, is above the state's average (9.5%) [1,2]. 9% of the population (414 of 4768) are students [1]. Municipal taxes come from a 5% bed tax, 2% raw fish tax, property taxes and 3% sales tax [4]. In 2012, the municipal revenue was $25 million [3].

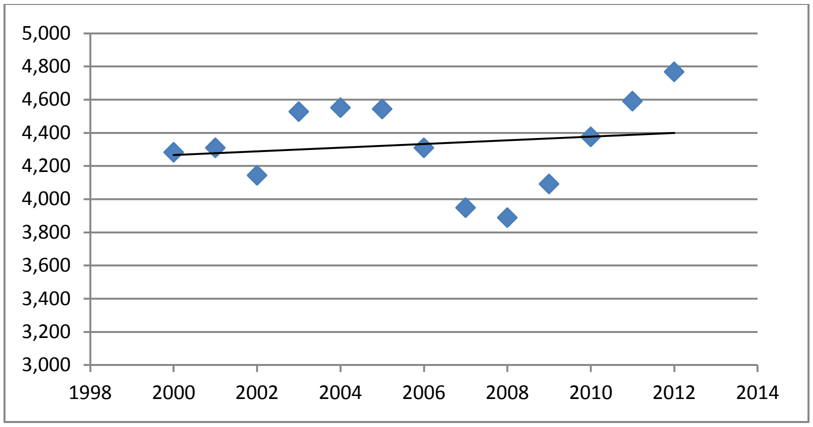


Figure 153: Unalaska Population 2000-2012 [3]

Over the past twelve years, Unalaska has experienced a cyclical population trend, with the past four years being an upswing. Smoothing out the sinusoidal population deviations, Unalaska has averaged less than 1% population growth per year.

ENERGY SNAPSHOT

- Fuel supply and costs: more than sufficient bulk fuel storage exists in Unalaska. Fuel costs are lower than the regional average.
- Electricity: The City of Unalaska owns and operates the electrical utility in Unalaska. Electricity is generated by diesel. Although Unalaska is by far the largest electricity market in the region, it experiences merely average residential rates.
- Heating: The heating needs of Unalaska, like much of rural Alaska, have not been researched in depth. Diesel is the primary heating fuel. The power house has a heat recovery system. Significant, but unknown industrial heating loads exist.
- Research: Considerable research has been done on alternate energy sources for Unalaska, primarily the Makushin geothermal prospect.
- Opportunities
    - Renewable Energy sources: Unalaska has a number of potentially viable alternate energy sources: hydro, wind, and geothermal are all possibilities in decreasing order of cost effectiveness.
    - Energy efficiency: By implementing economically viable energy efficiency and weatherization projects, Unalaska could potentially decrease its diesel consumption by 6 million gallons diesel, and saving $20 million per year.

EXISTING RESEARCH AND STUDIES

There are numerous existing reports addressing renewable energy production Unalaska, particularly the Makushin geothermal prospect. Below is a representative sample of reports.

- 1980 -
  - **Regional inventory and reconnaissance study for small hydropower projects. Aleutian Islands, Alaska Peninsula, Kodiak Island, Alaska. Volume II: Community Hydropower Reports.** Department of the Army, Alaska District, Corps of Engineers. October 1980.
- 1984
  - **Final Small Hydropower Interim Feasibility Report and Environmental Impact Statement**. US Army Corps of Engineers. June 1984.
  - **1983 and 1984 DGGS Geothermal Fluids Sampling and Well Logging at the Makushin Geothermal Areas**. R.J. Motyka and L.D. Queen. December 1984.
- 1985
  - **Evaluation of the Makushin Geothermal Reservoir, Unalaska Island**. Michael J. Economides, Charles Morris, and Don Campbell. January 1985.
  - **Overview of Pyramid Creek Hydro Project**. Energy Stream. Inc. January 1985
- 1993
  - **North Fork Pyramid Creek Hydropower Study**. Polarconsult. January 1993.
- 1994
  - **Geothermal resources of the Aleutian arc**: Alaska Division of Geological & Geophysical Surveys Professional Report 114, Motyka, R.J., Liss, S.A., Nye, C.J., and Moorman, M.A., 1994.
- 1997
  - **Rural Alaska Hydroelectric Assessment: Stage 2 Economic Evaluation of Hydroelectric Projects i Atka, Hoonah, Old Harbor, and Unalaska.** Steve Colt. July 1997.
- 1999
  - **Wind Energy Feasibility Study Naknek and Unalaska, Alaska**. Department of Community and Regional Affairs. 1999.
- 2005
  - **Wind Integration Assessment: Phase 1 Report.** Northern Power Systems. February 2005.
- 2012
  - **Alternative Resource Study: City of Unalaska**. the Financial Engineering Company. November 2012.

EXISTING FUEL FACILITIES

Like most rural Alaskan communities, Unalaska uses #2 diesel to produce both power and heat for the buildings in their community. Unalaska serves as a regional hub for fuel deliveries to regional communities. Unalaska is served by multiple fuel shipping companies from Cook Inlet and West Coast Refineries [5].

Fuel	Number of Tanks	Storage Capacity	Owner
Multiple	17	16,000,000	Delta Western Fuels
Multiple	15	4,000,000	Petro Star
Multiple smaller tanks for utility, processors, etc.			

Unalaska Fuel Storage Capacity[6]

Fuel prices

Unalaska receives frequent fuel shipments, but still experiences price instability due to global commodity prices. The following table shows the current 2013 fuel prices for #2 diesel.

Fuel	2013 Price	Uses
#2 Diesel	$3.50/gal (6/2013) [7]	Power Generation
#2 Diesel	$4.90/gal (March 2013) [8]	Residential heating, fishing boats, etc.

2013 Unalaska Fuel Prices

A significant difference exists between the reported #2 diesel price for power generation ($3.50/gallon) and the retail price ($4.90).

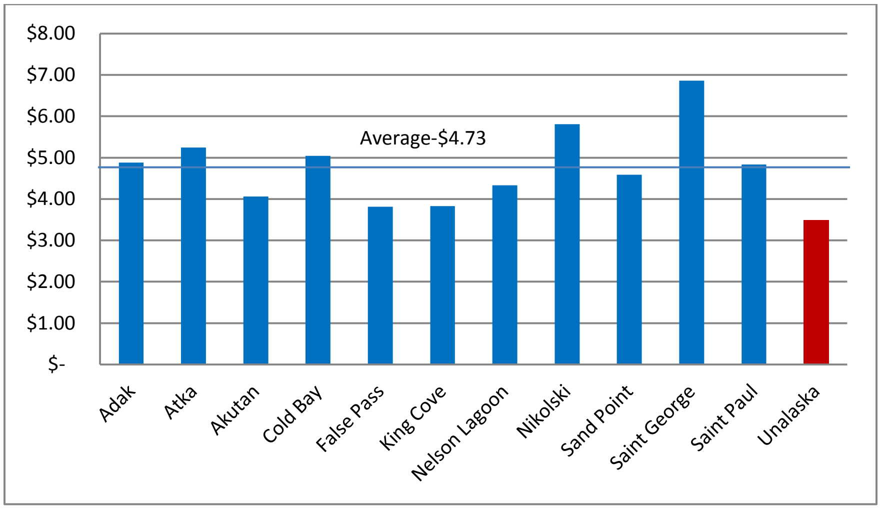


Figure 154: Average Price per Gallon of Diesel FY13 [7]

As can be seen in the chart above, Unalaska has a reported diesel fuel price that is well below the regional average.

EXISTING POWER GENERATION SUMMARY

The City of Unalaska owns and operates the electric utility in Unalaska. The city's power is supplied by the diesel plant which has a generating capacity of 19 MW.

Unalaska's electricity production statistics are shown in more detail in the table below. The PCE data from which it is derived from has multiple data gaps and inconsistencies which makes some of the information suspect.

Average Load	4,583	*kW*
Peak Load	8,840	*kW*
Diesel electric production	>40,000,000	*kWh/year*
Diesel used for generation per year	2,445,886	*gal/year*
Diesel efficiency	16	*kWh/gal*

Unalaska Electricity FY13 Production [7]

Generator Status

The Unalaska generation system includes seven diesel gen-sets with a total capacity of 19 MW (megawatts). The switch gear is semi-automatic synchronizing [9]. Below is a summary of the generators and their status.

Generator Capacity, Type, and Year of Installation [9]					
Generator	Rated Capacity	Type	Year Installed	Hours of Operations	Condition
Unit #10	5400 kW	Wartsila 12V32	2010	8,831	Good
Unit #11	5400 kW	Wartsila 12V32	2010	8,549	Good
Unit #13	4600 kW	C280-16 Caterpillar Diesel Electric Generator	2011	2,942	Good
Unit #8	1180 kW	3516 Caterpillar Diesel Electric Generator	1989	161,819	Fair
Unit #9	1230 kW	3512-B Caterpillar Diesel Electric Generator	1993	123,979	Fair
Unit #15	250 kW	C9 Caterpillar Diesel Electric Generator	N/A	29.5	Good
Unit #7	1000 kW	3512 Caterpillar Diesel Electric Generator	N/A	N/A	Fair
Total Generating Capacity	19,060 kW				

Other

The power house is generally in very good shape. The distribution was described as being in good condition, with meters being improperly installed. The system load is out of balance by less than 10%. The health and safety inspection showed that the system was code compliant [9].

ELECTRICITY PRICE

The City of Unalaska's electricity prices for 2013 are shown below. Prices depend on if the client is residential or commercial and on whether the client is eligible for the Power Cost Equalization (PCE) program administered by AEA. Most residents and some community facilities receive PCE credits to lower the cost of electricity. The PCE program gives each eligible resident a credit to defer high electricity costs for the first 500 kWh of electricity used per month. The resident will not obtain PCE credits for any electricity used over the 500 kWh per month limit. The program also allocates a specific number of kWh in PCE credits to all eligible community facilities to share. This allocation is calculated as the population multiplied by a factor of 70 kwh per person for all eligible community facilities.

Residential price with PCE	21 cents/kWh
Residential price without PCE	45 cents/kWh
Commercial price (reported)	40-50 cents/kWh

2013 Unalaska Electricity Prices [7]

As can be seen in Figure 155 below, Unalaska has post costs below the regional average before PCE, but at the regional average after PCE reimbursement.

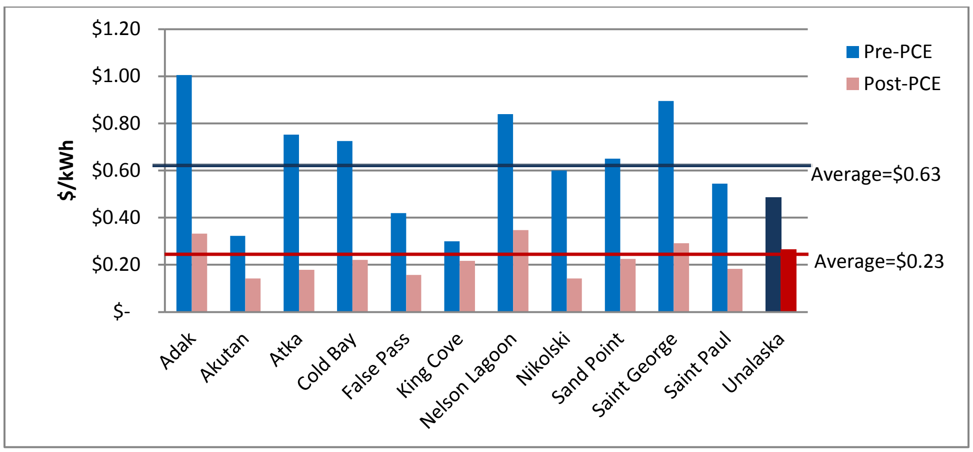


Figure 155: Regional Cost of Electricity FY13 [7]

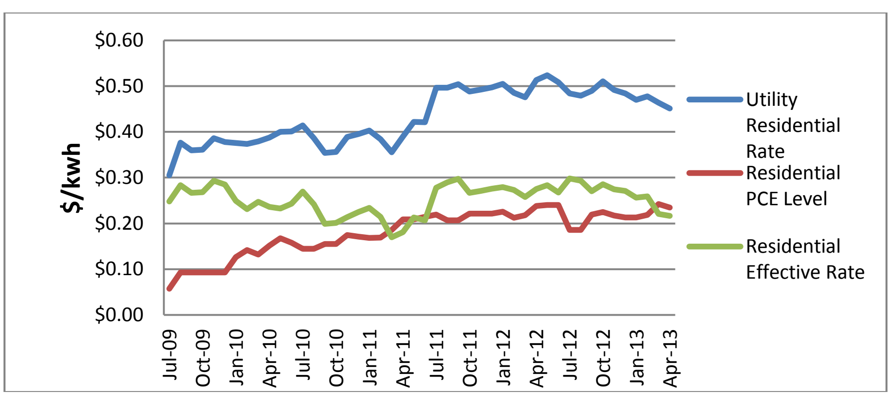


Figure 156: Unalaska Residential Electricity Prices FY10-FY13 [7]

The unsubsidized cost of residential electricity has increased by more than one-third in the past four year, with significant month to month volatility, as shown in Figure 156 above. The effective residential rate (the rate that a household would pay for the first 500 kWh per month as subsidized by PCE) experienced significant levels of volatility, rising and falling 50% in the course of a few months. Even so, the effective residential rate is now actually lower than it was four years ago.

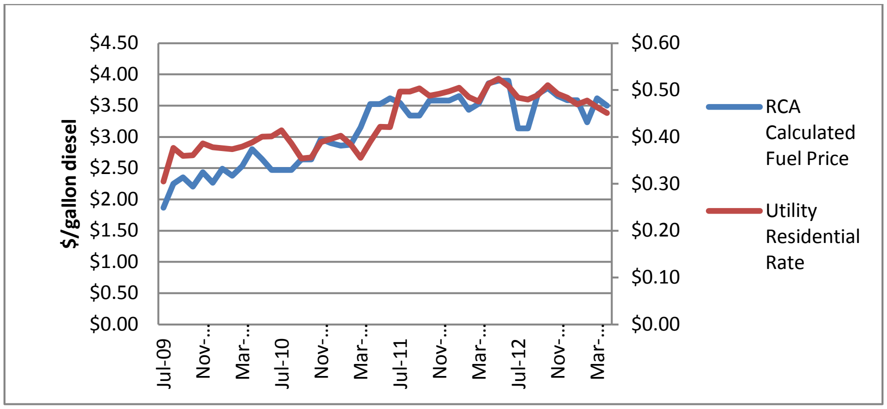


Figure 157: Price of Diesel Fuel and Residential Electricity Rate FY10-FY13 [7]

It is generally assumed that electricity rates in rural Alaska are tied directly to the price of diesel fuel. As can be seen in Figure 157, this seems to be the case in Unalaska. A strong correlation can be seen between price of diesel and the unsubsidized residential rate.

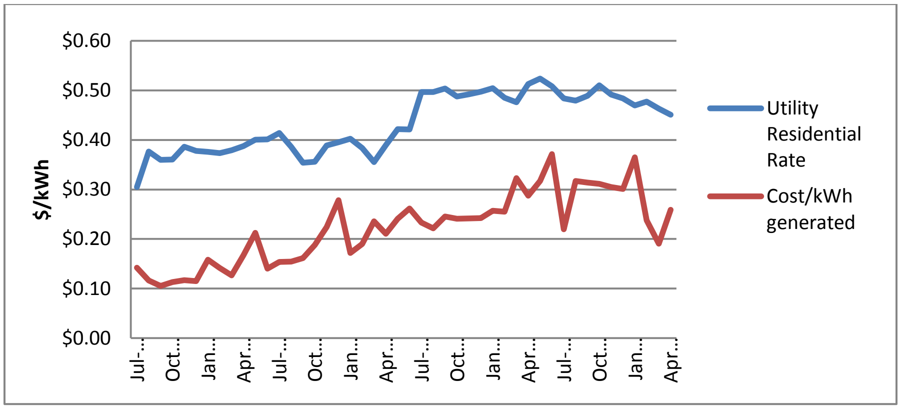


Figure 158: Residential Rate vs. Total Reported Cost of Generation per kWh FY10-FY13 [7]

The residential rate must cover all generation expenses. Generation expenses include the cost of fuel but also operations and maintenance (O&M) for the entire generation and distribution system, and major repairs and replacement for the system. While the total cost of generation is artificially low in some months, as Unalaska did not report any non-fuel costs in many months to the PCE program, there is a trend of maintaining the retail cost of residential electricity nearly $0.20/kWh greater than the reported generation costs, as seen in Figure 158 above.

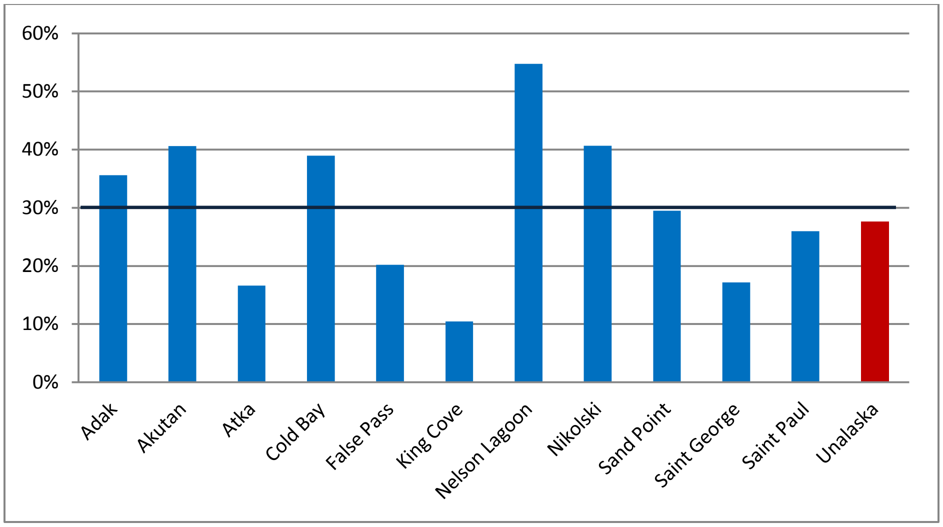


Figure 159: Non-Fuel Costs as Percentage of Total Electricity Cost

For the past four fiscal years, the non-fuel costs at Unalaska have been below average for the region, but as noted earlier non-fuel costs were not reported for 2.5 years of the four years and this value is based on extrapolating from the available data.

COMMUNITY POWER LOAD

The City of Unalaska provides power to approximately 694 residential, 203 non-PCE eligible (commercial) and 56 community facilities. The annual community power consumption is nearly 42 million kWh per year, which includes only power sold to customers and does not include power that is used to operate the power plant or lost in distribution [10].

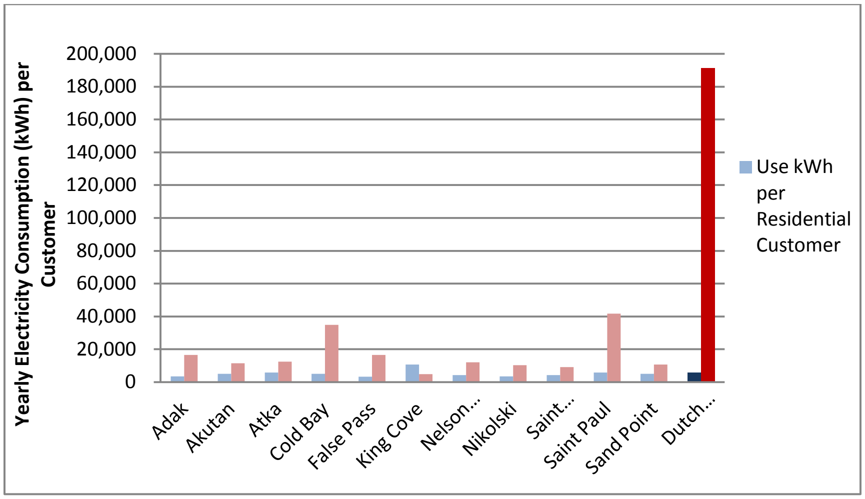


Figure 160: Average Yearly Electricity Consumption for Residential and Commercial Customers FY12 [10]

While the commercial consumption of Unalaska distorts the chart, Unalaska's residential customers are average for yearly consumption.

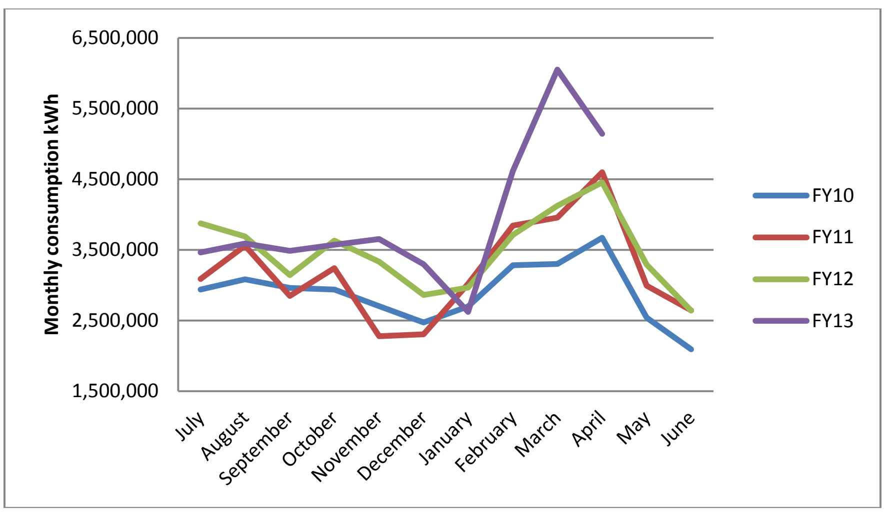


Figure 161: Unalaska Community Consumption FY10-FY13 [7]

Over the past four years, the electricity consumption has been fairly consistent with a 10-20% year to year difference on a monthly basis. The peak consumption is in the late-winter and spring, as seen in Figure 161.

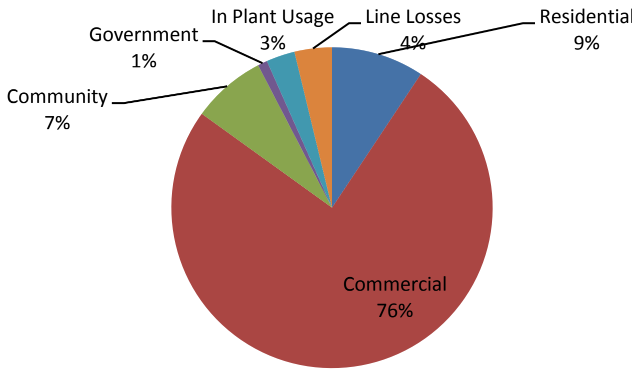


Figure 162: Unalaska Power Sectors FY10-FY13 [7]

The data gathered from the PCE program shows evident reporting and/or metering issues that complicates community analysis. Many months report more electricity being sold than was available within the system. In addition, no generation was reported in multiple months, thus much of the data may be suspect. The commercial consumption dominates the electricity system in Unalaska. Residential and community consumption are minor components.

Unalaska Consumption Statistics [7]						
	FY10	FY11	FY12	FY13	Average	
Gross Generation	37,195,002	38,450,553	44,932,348	18,558,502	34,784,101	kWh
Residential	3,992,738	3,936,564	4,068,216	3,418,243	3,853,940	kWh
Commercial	26,958,131	30,880,688	34,152,712	32,964,980	31,239,128	kWh
Community	3,309,744	3,133,279	4,068,216	3,418,243	3,482,371	kWh
Government	426,259	421,768	403,777	341,797	398,400	kWh
Distribution Losses	1,442,566	1,569,544	1,938,104	1,331,645	1,570,465	kWh
Peak Load	7,222	7,850	7,700	8,840	7,903	kW
Average Load	3,960	4,380	4,874	4,583	4,449	kW
Diesel Use	2,175,460	2,615,182	2,840,534	2,445,886	2,519,266	gallons/year
kWh/gal Generated	17.1	14.7	15.8	7.6	14	kWh/gallon
kWh/gal sold	15.9	14.7	15.0	16.4	16	kWh/gallon
Average per residential customer	$ 1,480.64	$1,226.50	$ 1,565.39	$1,302.80	$1,393.83	year

The table has a number of inconsistencies and data issues that need to be pointed out. The especially high diesel efficiency in FY10 is due to how the calculation was made--the total generation includes electricity purchased from outside sources. FY13 data is especially suspect: More than half of the generation was not reported. The diesel efficiency appears particularly bad, even though it is probably closer to the 15-16 kWh/gallon figure.

Projected Power Loads

Based on population projections developed by the Alaska Department of Labor & Workforce Development, it is expected that the population of the Aleutians East Borough will increase by 3% over the next 20 years [11]. While the report does not break out the projections by communities, if it is assumed that increase is uniform, and independent of any energy efficiency measures or high draw developments, we can project that the power requirements will increase slowly in the coming decades. given the cyclical population changes, no clear trend could be gathered from the previous decade's population data, although there has been an average of a 1% per year increase over the period.

Given the community's reliance on the fishing industry, any population projections are highly dependent on the health and sustainability of the fish stocks. The implementation of energy efficiency measures could result in a further decrease of electricity consumption by the city.

Royal Dutch Shell is using Unalaska as a base for offshore oil and gas exploration in the Beaufort and Chukchi Seas. The drilling program was put on hold in 2013 and no announcement has been made for when it will continue [12]. The impact of these activities on Unalaska's energy needs is uncertain.

COMMUNITY HEATING LOADS AND COSTS

Residential Building Quality and Heating Costs

No detailed community wide analysis of building quality has been done for Unalaska. Statistical data is available from the US Census's American Community Survey about the age of buildings and the type of fuel used for heating. The figure below provides the age distribution for houses in Unalaska. As can be seen, the majority of houses were built since the 1980s, with another spike in the 1940s (a result of World War II construction). The average age of housing is approximately 35 years [13].

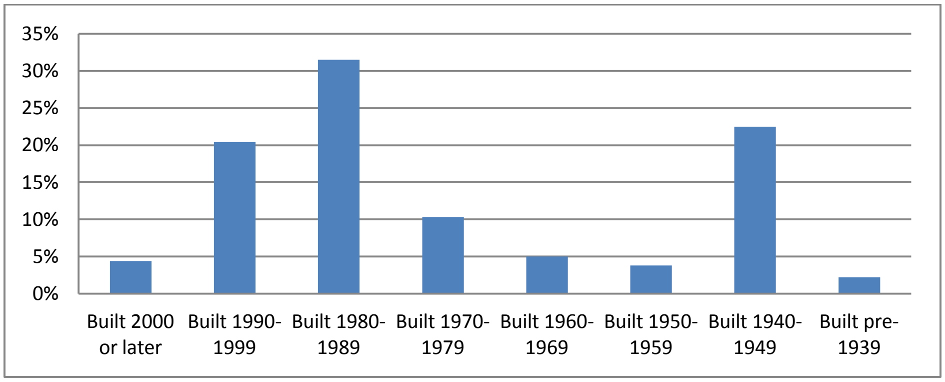


Figure 163: Age of Housing in Unalaska [13]

No community level analysis of annual heating costs have been performed, but a 2009 statewide study found that houses built prior to 2000 had annual energy costs of over $6,000. New housing, that is within the past ten years, had costs under $3,000 per year [14]. For simplification, we will assume that the Aleutian region on the whole has energy costs equal to the state's average.

Unalaska's heating fuel costs are below the regional average. Given the age of the houses, the average cost would be approximately $4,400/year. Since the average electricity costs are approximately $1,300 per year, heating should cost approximately $3,100 per year, or less than $300/month.

Community Heating Fuel Price

In the past four years, the price of heating fuel has increased by more than one-third in Unalaska. The price has remained below the region average and the difference has increased over that period. Although there was significant volatility between 2005 and 2011, the price has been fairly consistent for the past two years until a recent dip in price.

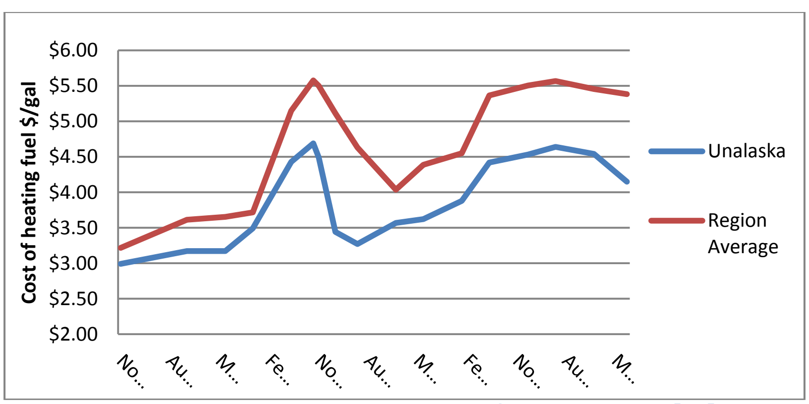


Figure 164: Unalaska Heating Fuel Cost 2005-2013 [15]

Community Heating Fuel Usage

Since the community of Unalaska does not use a unique fuel for heating, it is difficult to know precisely the amount of fuel the community uses for heating. As can be seen in the figure below, nearly 90% of the heating is provided by fuel oil. In 2010 the Alaska Energy Authority estimated that Unalaska consumes approximately 1,268,665 gallons to heat its buildings [16]. Given the size of the industrial load and need for process heat in the fish processing plants, this figure is too low, perhaps by an order of magnitude.

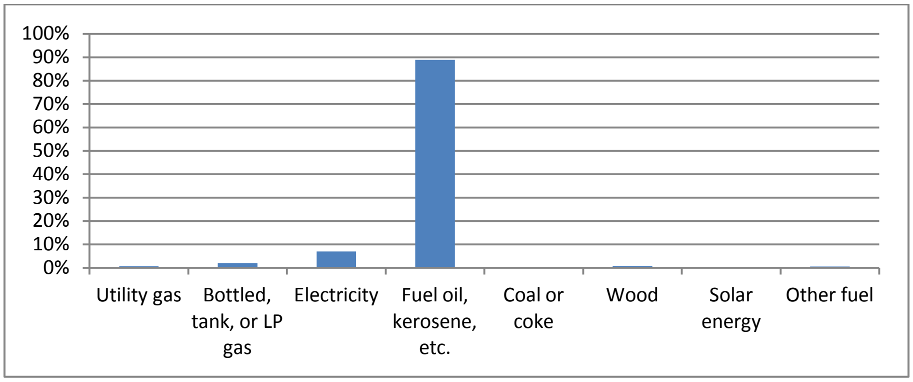


Figure 165: Fuel Used for Heat in Unalaska [13]

Existing Waste Heat Recovery

A waste heat recovery system is installed at this time in the City power plant and supplies heat to the building [9]. An AEA Renewable Energy Fund grant will test the viability of a low-temperature organic Rankine cycle (ORC) generator to use the waste heat to produce up to 150 kW of electricity [17].

OTHER EXISTING ENERGY SYSTEMS

The other energy systems in Unalaska--three fish processing plants--are apparently larger than the City's generation, with a combined load 50% greater than the City's. The processors loads have high volatility throughout the year and throughout the day, as power consumption is driven by the specific needs of the plant. Three large seafood processors--Alyeska, Westward, and Uni-Sea--each have a generating capacity comparable to the City's and have a combined load of approximately 62 million kWh/year. Maximum combined load between the City and processors is estimated to vary between 6 MW and 21 MW [18].

Alyeska Seafoods has a capacity of 4.5 MW from six diesel gen-sets. Other significant energy consumers include three steam boilers and 2 MW of freezers and cold storage. Alyeska processes the fish oil as a fuel to be blended with diesel--800,000 gallons in the peak year. In 2012, more than 1.4 million gallons of diesel were consumed for electricity and heat [19].

Westward Seafoods has a capacity of 6.6 MW from three 2.2 MW diesel gen-sets. When the plant cannot produce sufficient power, it purchases electricity from the City at about $0.50/kWh. Westward uses fish oil in boilers to produce steam. Total diesel consumption is approximately 1.7 million gallons, two-thirds for power production [20].

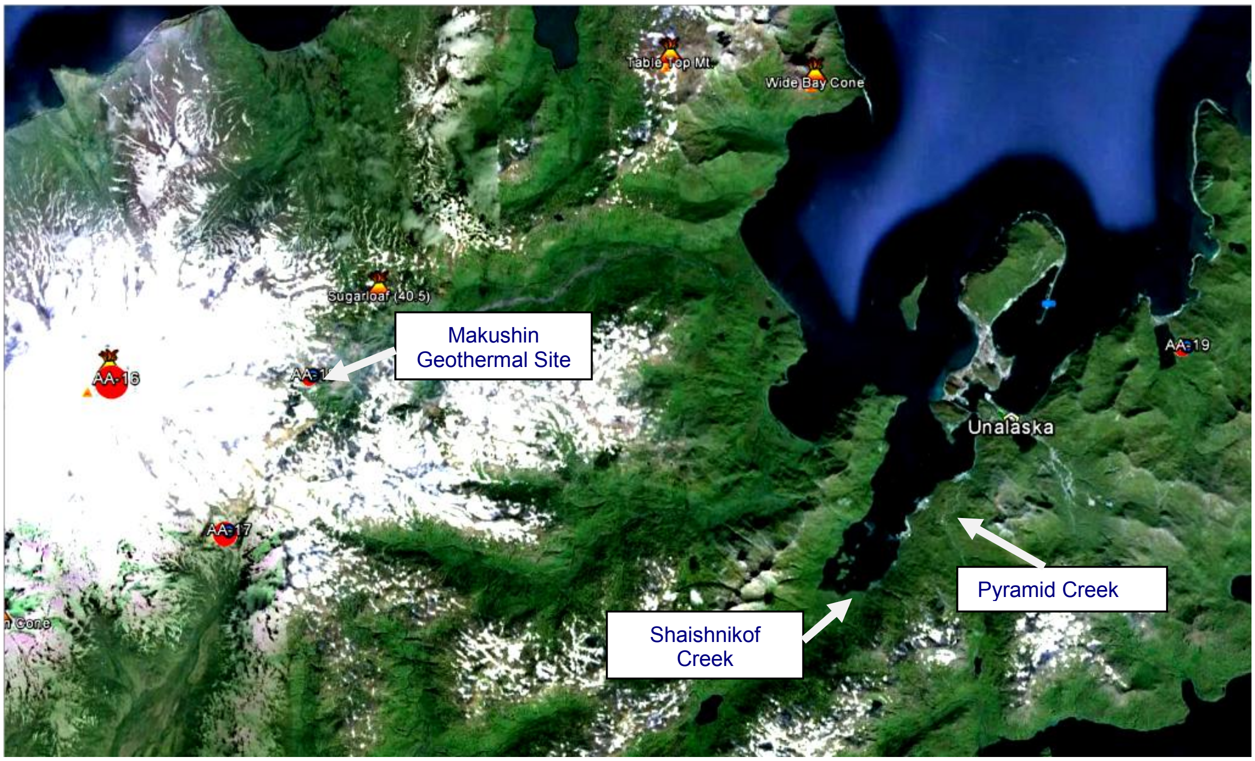
Uni-Sea Processor has a diesel generating capacity of 12 MW that was built in 1990, in addition to a 2.5 MW two-way grid connection. Fish oil is processed and has been used in gen-sets since 2002 in a 50/50 ratio with diesel. Approximately 400,000 gallons of fish oil are burned per year. No data on total diesel consumption was available [21].

APL Cargo maintains 2.2 MW of backup generation in case of a city blackout. Hundreds of refrigerated containers holding seafood waiting to be shipped (as seen in the photo above) must remain cold. APL purchases power from the City at a reported rate of $0.40/kWh [21].

ADDITIONAL POTENTIAL LOCAL ENERGY RESOURCES AVAILABLE IN UNALASKA

From background research and the March 2013 site visit, it was determined that Unalaska has four additional possible sources for renewable energy production. Upon completing a qualitative evaluation for each, the following ranking is as follows:

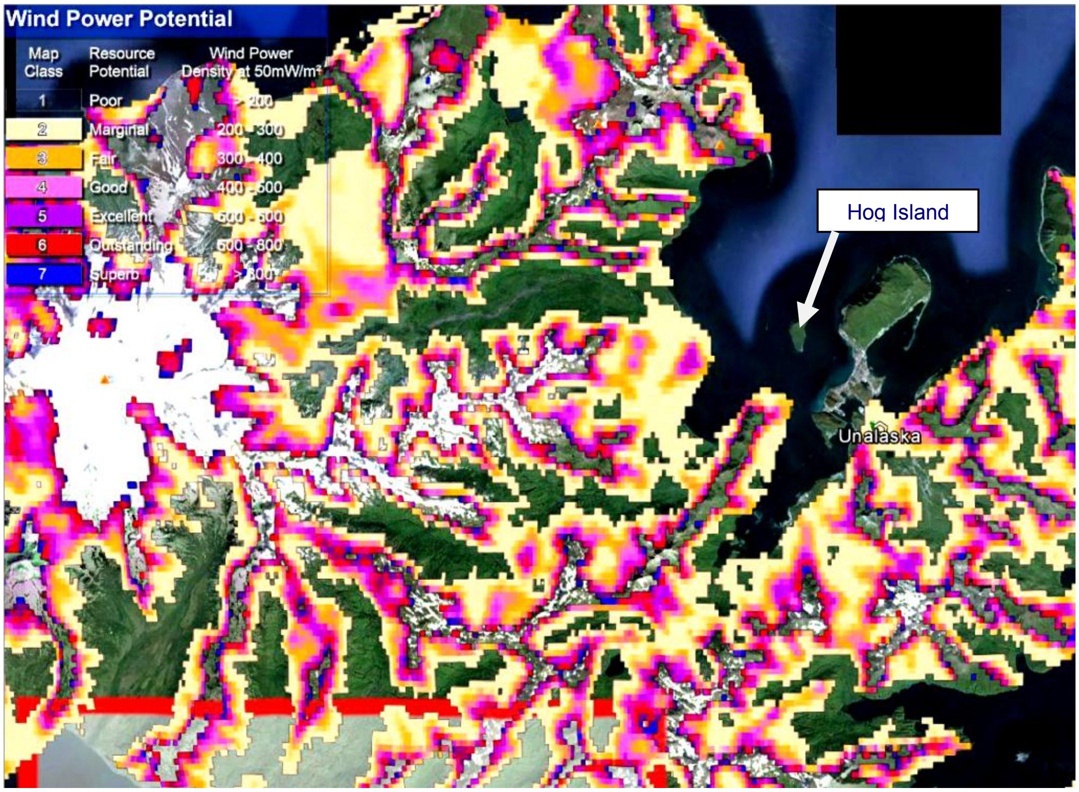
1. Hydropower-- Two potential hydro sources were identified in 1980, one with a capacity of 2450 kW and the other 400 kW [23]. Although unnamed in the report, they appear to be Shaishnikof and Pyramid Creek, respectively. A later analysis downgraded Shaishnikof to a 700 kW run of river project, and downgraded Pyramid Creek to 260 kW [24]. Pyramid Creek (also called Icy Creek) was deemed economical in 1994 and again in 1999 [25, 26]. Pyramid Creek, the source of city's water, has been investigated as a power recovery project primarily utilizing the existing infrastructure. A reference was found for a permitting effort in 1995-96 at Pyramid Creek, but no other references have been found for why it was not built [27].



2. Wind Power--As can be seen in the figure below, many highly energetic wind areas exist around Unalaska [27]. The wind resource in Unalaska has not been extensively studied. Three references to studies were discovered, but no results were found. In 1995-6, as part of permitting for Pyramid Creek, lower than expected wind speeds were found (lower than Class 5) [28]. Both Westward and Uni-Sea seafood processors collected wind data for two years each. Their results found inconsistent wind and summertime lulls [19, 20].

   A recent study looking at alternative energy possibilities for Unalaska decided wind would not viable resource due to regulation issues (both from historical protection and avian concerns) and the risk of failure from turbulence [18]. While these factors may complicate siting a wind power project, neither is a deal breaker. Turbines can be sited to minimize avian contact and a rigorous exploration program should be able to find a location with lower turbulence levels.

   The southern portion of Hog Island (labeled on the figure below) may have viable wind site that could be linked to the power plant via a submarine cable. The northern portion of the island is in the final approach path of the airport and permission from the FAA will be required for MET towers. AEA can assist the City in installing multiple 10-meter MET towers, at minimal cost, to determine the best location for erecting their existing 30-m met tower. [29]



3. Geothermal-- Significant exploration work has been accomplished at the Makushin geothermal site in the past thirty-five years by a combination of state, regional, and private interests, but the prospect remains undeveloped. The most serious exploration work took place in the early 1980s and was performed by the state Division of Geological and Geophysical Survey (DGGS). In 1982-1984 the DGGS was able to drill several temperature gradient wells and one test well (ST-1). The site, located near a fumaroles field and accessed via helicopter, confirmed a hot, shallow resource.

The thermal gradient wells in 1982 found a bottom hole temperature of 195C. In 1983 a three inch well was drilled nearby to 1,946 feet. A three foot fracture zone was found to develop 193C fluid. The static hole temperature (when fluid was not being developed from the well) was found to be 202C. The difference between the static bottom hole temperature and the flowing temperature indicates that the reservoir may be some distance from the well. From extended flow testing in August 1984, the small diameter well produced 47,000 lb/hr without any pressure loss [30]. Two periods of testing--15 days at 33,000 lb/hr and 19 days at 63,000 lb/hr, were promising but not not sufficient to definitively prove that the resource is economically viable and/or can produce sufficient fluid for a large-scale power plant [31].

Since the work by the DGGS, a number of private and government entities have looked into developing the resource, including OESI Power Corp., the State of Alaska, Exergy, Iceland America, the Aleut Corp., and the City of Unalaska. As one example, in the 1990s OESI Power Corporation developed a plan to develop the resource. OESI planned on the state owning the infrastructure with OESI contracting to develop and run the resource, selling power for $0.12/kWh. No indication in the available documents explain why the deal fell through [32]. The plans put forth by OESI assumed a geothermal fluid production of 1,350,000 lbs/hr, a significant increase of the 47,000 lb/hr produced in the small diameter 1984 flow test [33].

The City of Unalaska has a state grant for $1.5 million to explore lower Makushin Valley, an area that would have lower infrastructure expenses but no exploration data. No funds have been spent to date [34].

A recent study indicated that the geothermal resource presented greater risk than the City can take on. Debt financing would require long term commitments that the processors would be unable to provide due to the uncertain nature of the fishing industry. Serious difficulties and upfront capital expenses are necessitated before the resource can be proven. A large diameter production well can only be drilled by a rig that can brought via an access road, an infrastructure project estimated to cost $40 million [18]. Only after drilling a large diameter well will it be certain that the resource is sufficiently robust for a 10-20MW plant.

In 2009 a preliminary cost estimate for developing the resource, based on a 10 MW project, estimated total capital costs of between $100-244 million [35]. As part of an application for a AEA Renewable Energy Fund Round 6 grant, the Aleut Corporation provided an estimate of $311 million for a 30MW plant, which would be significantly oversized for the island's load [36]. For multiple reasons, including a lack of coordination between stakeholders, this application was rejected [37].

4. Heat Recovery: In lieu of using the waste heat from the diesel gen-sets for heating public buildings, the City of Unalaska is using a $1.3 million AEA RE Fund grant to install a 150 kW ORC generator [17]. It is yet to be proven if this is a more cost effective solution to using waste heat than using it directly to heat community buildings.

Other Energy Resources not currently viable

1. Biomass--It appears that all fish oil produced by the fish processors is being used internally for heat and/or power production [19, 20, 21] . Insufficient woody biomass exists in the region to be used as an energy source [37].

2. Ocean Power--Using available NOAA data on ocean currents, the Electric Power Research Institute (EPRI) identified four potential tidal power sites, included in the table below [38]. Although the total resource potential (more than 300 MW), all sites are a great distance from the city. Additionally, ocean technologies--both tidal and wave--remain too immature to be economically and technically successful in a remote location without significant subsidy and risk.

Site	Electric Generation Potential MW	Distance
Umnak Pass	57	63.6
Akutan Pass	140	21.5
Baby Pass	21	19.9
Unagala Pass	110	13.9

3. Solar--At an average insolation of less than 2kWh/m^2/day area has insufficient sunlight for PV or solar thermal [39].

4. Hydrocarbons--No proven oil & gas reserves have been shown within the Unalaska area. No coal reserves are found in the vicinity [40].

Natural Gas

Since no natural gas resources have been identified locally, liquefied natural gas (LNG) would need to be brought to Unalaska. Cleaner burning and lower in cost than diesel per unit of energy, natural gas might be another energy choice for Unalaska. A detailed study needs to be performed to identify the costs of converting the energy infrastructure--for both power generation and heating--for the City and three major fish processing plants. The economics of the project hinge on these conversion costs, the absolute amount of diesel that can be displaced by natural gas, and the per unit delivered cost differential of LNG and diesel. What follows are some necessities for looking into the LNG option.

LNG is created when natural gas is pressurized and cooled sufficiently for it to be liquid (below -260F). The reduced volume eases the transportation of natural gas, so that the liquid can then be stored and transported, something that is now commonly done across the globe. The LNG can be delivered in large bulk tankers, something that would be significantly larger than Unalaska's yearly consumption, or smaller individual tanks (10,000 gallons or smaller). Large central tanks would likely need to be constructed to hold the island's gas supply.

The existing diesel generation infrastructure would likely be able to be converted to burn natural gas, although some units may not be suitable. The gen-sets can be set as dual fuel systems that can run any combination of diesel and natural gas.

The centralized costs are a large unknown. The central storage, regasification, and distribution are largely unknown. A recent study used a cognate in BC to estimate a total capital cost of $70 million, but few details were provided to check the estimate [18]. For the system to be cost effective natural gas will likely need to replace diesel for almost all uses--power and heat alike. Just for residential customers the replacement of diesel furnaces and boilers could cost more than $10 million (assuming $15,000 per conversion and 700 residences).

If natural gas displaced the nearly 10 million gallons of diesel fuel used for power and heating in Unalaska, unintended consequences may result regionally. Since Unalaska's fuel usage dwarfs the rest of the region, regional fuel prices would likely rise as the volumes of fuel being brought to the regional hub were slashed.

ENERGY EFFICIENCY

Current Energy Efficiency Projects

COMMUNITY ENERGY EFFICIENCY GRANT FUNDED PROJECTS [41]						
Program	**Infrastructure**	**Buildings**	**Identified Savings (MMBTU)**	**Identified Savings ($)**	**Implemented Savings (MMBTU)**	**Implemented Savings ($)**
VEEP	-	-	-	-	-	-
EECBG	2	0	1,468.30	$141,969	677.4	$65,497
AHFC Public Facility	-	-	-	-	-	-
AHFC Commercial (AHFC-C)	-	-	-	-	-	-
AFHC Residential (AHFC-R)	0	30	N/A	N/A	N/A	N/A
Alaska Commercial Energy audit	0	3	1,041.79	$43,380		
Totals	2	33	N/A	N/A	N/A	N/A

The State of Alaska has a number of energy efficiency programs--as described earlier in the introduction, and listed in the table above--that can provide meaningful energy price relief for communities, businesses and residents by decreasing the energy required to heat buildings and provide light. Particularly given the high energy costs, it has not availed itself of the current state programs.

Potential Energy Efficiency Projects

Residential				
Residences	Potential Residences to be Improved	Potential Yearly Residential Savings (MMBtu)	Gallon diesel equivalent saved per year	Potential Yearly Savings ($)
927	897	43,000	308,000	$1,052,000

Unalaska has significant room for increasing residential energy efficiency. State programs could still help offset residential energy prices, particularly for heating. As only thirty residential housing units have been assessed and improved through the AHFC Residential weatherization program, more than 90% of housing units could realize benefits discovered by an energy audit.[23] While state aid is limited, the potential savings only include those measures that are financially worthwhile even without government subsidy.

Weatherization program in the region average 37% in annual energy savings, presumably in heating costs [43]. The 36 households in the Alaska Peninsula/Aleutian region that took part in the Home Energy

[23] To estimate for potential residential energy efficiency improvements are intentionally conservative. Data from the current AHFC Residential program was used to determine an average potential savings per residence. Diesel equivalence assumed all savings as heating. To be conservative, a 100% heating efficiency was assumed. The value of diesel saved is based on FY12 diesel costs for the community as reported to PCE [42].

Rebate Program saw an average energy savings of 28% and a cost savings of $2,332 per year. The rebate program paid $5,037 per retrofit [44]. No data for the cost to homeowners was available.

Commercial				
Commercial Customers	Potential Customers Served	Potential Commercial Savings (MMBtu)	Gallons diesel equivalent saved per year	Potential Year Savings ($)
182	182	803,963	5,742,592	$ 19,584,554

Significant opportunities also exist for Unalaska's commercial sector. More than 180 potential customers could benefit from energy efficiency programs. Energy savings in the commercial sector are more likely to save electricity than heating fuel especially through lighting upgrades.[24] An unknown amount of diesel is used for industrial heating and direct power in the fish processing plants, docks, and other industrial processes.

Total		
Total MMBtu saved per year	Gallons diesel equivalent saved per year	Total Savings per year
900,000	6,400,000	$ 21,000,000

The total number of gallons of diesel consumed in Unalaska for heating and electricity is unknown. Due to the uncertain loads for fish processing and the transportation sector, the estimates produced by AEA for heating and electricity (~4 million gallons) are surely too small for the amount of industry on the island [15]. An estimate of nearly 6,400,000 gallons represents an unknown percent reduction in diesel consumption.

[24] To estimate the potential commercial opportunity a number of assumptions were made. The average from the AHFC Commercial program was weighted by how the average commercial customer in the community compared to the regional average. The diesel equivalence saved does not include any conversion efficiencies and assumes that all Btus are supplied directly by diesel fuel. If measures save electricity, this methodology significantly underestimates the diesel saved.

RECOMMENDATIONS

What follows are qualitative recommendations for deployment scenarios in the short-term (<5 years) and longer term (>5 years). Prior to the implementation of any of the projects recommended below, the technical viability and economic feasibility must be studied in more depth. The economic and technical evaluations required are beyond the scope of this report. Below are the most likely energy deployment scenarios for the community given the state of energy technologies.

Short Term (<5 years)

Community Planning for Energy: Plan development with an eye to maximize community-wide energy efficiency. Site development to facilitate potential district heating and allow for integration of alternate and distributed generation.

Energy Efficiency: Improving the energy efficiency of residential and commercial buildings involves using proven technologies and techniques that are economically justified. Generally the simple payback periods are short, even without government assistance. Numerous government programs exist to provide assistance for individuals and communities. Local government entities could help the community in numerous ways to coordinate activities, educate citizens and companies about the personal and community-wide benefits, and identify and remove barriers to action.

- *Residential*: Lower heating loads for residences, improve livability, low payback periods. Government coordination can help to educate the community, ease the planning process, facilitate bulk purchasing of materials, and act as a leader for the process.
- *Commercial*: By lowering electrical loads through efficiency measure, businesses can decrease their energy costs, lower their exposure to price volatility, and improve profitability. Heating costs can be decreased through insulation and weatherization measures.

Hydroelectric: Although neither the Pyramid Creek or Shaishnikof Creek will be able to supply all of Unalaska's power, they could both provide a meaningful reduction in diesel consumption. Preliminary studies should be started to look into developing these resources.

Wind Resource identification: The City of Unalaska should investigate areas for a suitable wind resource. Using previous studies, noted earlier, and erecting multiple small met towers in potential locations, a large 30-m met tower can be erected in the coming years.

Natural Gas: A detailed study on the costs and benefits of importing LNG to Unalaska needs to be performed. Infrastructure changes and LNG shipments could begin in the short term planning horizon.

Geothermal: Even with the exploration work performed by the DGGS in the 1980s, the Makushin prospect remains a high risk/high reward project. Given the obvious technical and economic risks, the stakeholders must work together to tackle the risks together. The differences between the various landholders and stakeholders must be ironed out before any development of the Makushin resource is possible. An updated cost estimate for a properly sized project should be developed. A preliminary project plan accepted by all stakeholders (landowners, City, Aleut Corp., fish processors) must be finalized before a unified development proposal can be brought to AEA's RE Fund for consideration.

Long Term (>5 years)

Hydroelectric Power: If the preliminary studies continue to show that Pyramid Creek and Shaishnikof Creek are still economically viable, the resources should be developed.

Wind generation:

- If a suitable site can be found, wind power should be integrated into the City's distribution system.
- As electricity storage systems (batteries, ultracapacitors, flywheels, etc.) decrease in price and increase in durability, excess wind may be stored for times when the wind is not blowing. This stored electricity along with the hydroelectric power could replace the diesel generation. Excess wind and hydro generation could also be used for distributed heating, providing residential heating.

High efficiency buildings

- Current technology allows for radically cuts in residential and commercial buildings. Drastically improved insulation and sealing techniques could have a positively disruptive effect on the energy requirements in Unalaska while maintaining or improving living conditions. Because of the low turnover in the housing and commercial stock, the process for implementing high efficiency buildings would be a long-term goal. More immediate energy efficiency changes can be implemented to act as a bridge towards longer term goals.

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